

## CLAIMS

1. Anchoring device for stabilising an excavation wall, and to be at least partially engaged into a bore drilled into the excavation wall, said anchoring device comprising:

- an elongated support member defining a distal end for engagement into the drilled bore, and a proximal end opposite said distal end;
- a bearing member mounted on said support member proximate to said proximal end thereof, for bearing against an exterior surface of the rocky bed; and
- an anchoring head mounted on said support member and for engagement into the drilled bore of the excavation wall, said anchoring head comprising:

- a flexible expansion member mounted on said support member, made from an elastic material and adapted to stretch and radially widen; and

- an actuation member movably mounted on said support member, said actuation member mounted for relative movement to said support member and to said expansion member and engageable with the latter, said actuation member adapted to exert a pressure on said expansion member;

wherein for anchoring said anchoring head into the excavation wall at the level of the bore drilled therein, said actuation member and said expansion member must be moved relative to one another so as to enter into contact with one another, and in such a way as to enable said

actuation member to exert a pressure on said expansion member to generate radial expansion of at least one portion of the latter, so that said portion of said expansion member comes to frictionally abut against a part of the internal surface circumscribing the drilled bore in the excavation wall.

2. An anchoring device as in claim 1,

wherein said expansion member is an elastic expansion sheath of cylindroid shape defining a first end and a second end, and an interior cavity engaged by said support member.

3. An anchoring device as in claim 2,

wherein said support member is an elongated rigid rod, defining a longitudinal axis extending in between said distal and proximal ends thereof.

4. An anchoring device as in claim 3,

wherein said elongated rigid rod is at least partly threaded, and wherein said actuation member defines a longitudinal interior cavity having a peripheral wall being also at least partly threaded and threadedly engages said rod, and in that said rod is pivotable around said longitudinal axis to generate a displacement of said actuation member threadingly axially along said rod, to enable relative displacement of said actuation member relative to said expansion sheath.

5. An anchoring device as in claim 4,  
wherein said cavity of said expansion sheath defines a first mouth proximate to said first  
end of said expansion sheath, and wherein said actuation member comprises an insertion  
member movable axially along said rod when the latter is pivoted around its longitudinal  
axis, said insertion member at least partially engageable into said interior cavity of said  
expansion sheath by said first mouth, to apply radially outward pressure on a peripheral  
surface of said interior cavity of said expansion sheath at least proximate to said first end  
thereof, to generate stretching and radial expansion of said expansion sheath at least  
proximate to said first end thereof.

6. An anchoring device as in claim 5,  
wherein said insertion member is an insertion wedge comprising a frusto-conical portion,  
said insertion wedge at least partially engageable into said internal cavity of said  
expansion sheath by said first mouth thereof to generate expansion and radial stretching  
of said expansion sheath at least proximate to said first end thereof.

7. An anchoring device as in claim 6,  
further including a retention member mounted stationary onto said rod, said second end  
of said expansion sheath being abutable against said stationary retention member when  
said insertion wedge engages into said first mouth of the interior cavity to radially  
outwardly stretch said expansion sheath.

8. An anchoring device as in claim 7,

wherein said cavity of said expansion sheath defines a second mouth opposite said first mouth and located proximate to said second end of said expansions mouth, wherein also said retention member comprises a second insertion wedge defining a second frusto-conical portion, said second insertion wedge engageable into said second mouth of said cavity of said expansion mouth when said insertion wedge moves toward said expansion sheath and pushes the latter towards said second insertion wedge.

9. An anchoring device as in claim 4,  
further including a retention member mounted stationary on said rod, and wherein said actuation member is a push member movable along said rod and which can push said expansion sheath against said retention member so as to axially compress said expansion sheath and to generate radial expansion thereof.

10. An anchoring device as in claim 9,  
further including a hollow sleeve engaged by said rod and maintained in axially stationary fashion thereon, and defining a main cylindrical portion and a rear annular stopper projecting radially outwardly from one of the ends of said main cylindrical portion, said rear stopper forming said retention member, said main cylindrical portion of said sleeve engaging said interior cavity of said expansion sheath.

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11. An anchoring device as in claim 10,  
wherein said push member comprises an expansion shell having a first end portion being annular and hollow and slidably engaging said main cylindrical portion of said sleeve, so

that said expansion sheath can become wedged between said annular end portion of said expansion sheath and said rear stopper of said sleeve, said expansion shell further comprising a number of blades having a toothed exterior surface, said push member further comprising an insertion wedge movably threadingly mounted to said threaded rod and movable toward said expansion shell, both to engage between said blades of said expansion shell and to generate their spreading apart to enable their being applied against the peripheral surface circumscribing the drilled bore in the excavation wall, and to slidably push said first end portion of said expansion shell along said main cylindrical portion of said sleeve and against said expansion sheath and to generate axial compression of the latter, and consequently the radial expansion thereof to enable its being applied against the peripheral surface circumscribing the drilled bore in the excavation wall.

12. An anchoring device as in claim 1,

wherein said bearing member is a bearing plate.

13. An anchoring device as in claim 1,

wherein said rod is provided with at least two anchoring heads to increase the number of anchoring points along the drilled bore in the excavation wall, so that said anchoring device may resist to stronger loads.

14. An anchoring device as in claim 1,

wherein said expansion sheath comprises at least one elongated band fixedly secured to an exterior surface of said expansion sheath.

15. An anchoring device for stabilising an excavation wall from a rocky bed, and to be at least partially engaged into a bore drilled into the excavation wall, said anchoring device comprising:

- an adjustable diameter tube, for engagement into the drilled bore in the excavation wall, and having an exterior surface for applying a radially outward pressure on the internal surface of the bore;

- a bearing member mounted on said tube proximate to a proximal end thereof, for bearing against an exterior surface of the excavation wall;

- an elongated rigid rod defining a distal end engaged into said tube, and a proximal end opposite said distal end thereof, said rod defining a longitudinal axis extending between said distal and proximal ends thereof; and

- an anchoring head mounted on said rod and engaged into said tube, said anchoring head comprising:

- a flexible expansion member mounted on said rod, made from an elastic material and adapted to stretch and radially widen; and

- an actuation member movably mounted on said rod, said actuation member mounted for relative movement to said rigid rod and to said expansion member and engageable with the latter, said actuation member adapted to exert a pressure on said expansion member;

- wherein to bring into operational condition said anchoring device, said rod and said anchoring head must be engaged into said tube, said tube having previously been engaged into the drilled bore of the excavation wall, and then said actuation member and said expansion member must be moved relative to one another for engagement with one another, so as to enable said actuation member to apply a pressure on said expansion member to generate radial expansion of at least a portion of the latter, so that said portion of said expansion member come to apply a radial pressure against an internal surface of the tube to enable increase of the pressure applied by said external surface of said tube against the internal surface of the bore.

16. Anchoring head to be installed onto a rigid rod, and adapted to be anchored into a

bore drilled into an excavation wall from a rocky bed, said anchoring head comprising::

- a flexible expansion member for mounting onto the rod, made from an elastic material and stretchable and which can be radially widened; and

- an actuation member movably mounted on said rod, said actuation member mounted for relative movement to said expansion member and engageable with the latter, said actuation member adapted to exert a pressure on said expansion member;

wherein for anchoring said anchoring head into the rocky bed at the level of the bore drilled in the excavation wall, said actuation member and said expansion member must be

moved relative to one another so as to enter into contact with one another, and in such a way as to enable said actuation member to exert a pressure on said expansion member to generate radial expansion of at least one portion of the latter, so that said portion of said expansion member comes to frictionally abut against a peripheral internal surface

5     circumscribing the drilled bore of the excavation wall.

17. A method for making integral an instable rocky bed, this rocky bed comprising an uneven exterior surface circumscribing an access shaft, said method comprising the following steps:

- 10           a)     using a drilling machine to drill at least one elongated cavity through said exterior surface and into the rocky bed, the rocky bed forming an interior surface circumscribing this drilled elongated cavity, and an annular part of said exterior surface opening onto said access shaft;
- b)     providing an anchoring device comprising a rigid elongated rod defining a
  - 15           distal end part mounted into said elongated cavity, a proximal end part projecting outwardly from said elongated cavity, said anchoring device further comprising an elastic expansion member mounted on said rod, wherein said expansion member may be in a first unloaded condition, and frictionally engageable against said interior surface of rocky bed when
  - 20           biased in a second compressed condition, said anchoring device further comprising an actuation member movably mounted on said rod proximate said expansion member, said anchoring device further comprising, on said



proximal end part of said rod, a bearing member and also a tension biasing device;

- c) engaging at least one part of said rigid rod into said elongated cavity, starting with said distal end part thereof, so that said elastic expansion member and said actuation member mounted onto said rod are also engaged into said cavity, and so that said bearing plate and said tension biasing device release said cavity and be located proximate said annular part of said exterior surface of the rocky bed;
- d) moving said movable actuation member along said rod to engage said elastic expansion member so as to bias said expansion member to said second compression condition thereof; and
- e) adjusting said tension biasing device so that the latter frictionally engages said bearing member against said annular part of exterior surface of rocky bed.

18. Anchoring device for an unstable excavation wall, this rocky bed being of the type comprising an uneven exterior surface, circumscribing an access shaft, and at least one cavity drilled through this exterior surface and into the rocky bed, said device comprising:

- an elongated rigid rod, for engagement into this drilled bore, said rod comprising a distal part to be mounted into this drilled cavity, a proximal part for projecting outwardly from this drilled cavity;

- an elastic expansion member, mounted on at least a fraction of said distal part of said rod, said support member adapted to clear the interior surface of rocky bed in a first unbiased condition, but frictionally engageable with this interior surface of rocky bed once biased into a second compression condition;
- 5     - a movable actuation member for actuation of said expansion member, mounted on said distal part of said rod;
- a bearing member, mounted on said proximal end part of said rod; and
- a tension biasing device, mounted on said proximal end part of said rod, for frictional engagement of said bearing member against said annular part of exterior  
10     surface of rocky bed.